

CLAIMS

What is claimed is:

1       1. A method for operating an integrated circuit having an image sensor with at least one photoelement  
2 comprising the steps of:

3       (a) generating charge by the photoelement; and  
4       (b) applying at least a first portion of the charge generated by the photoelement to other circuitry to  
5 reduce consumption of power from a power supply.

1       2. The invention of claim 1, wherein the integrated circuit is powered by the power supply.

1       3. The invention of claim 1, wherein the photoelement is a photodiode, a phototransistor, a photogate,  
2 photo-conductor, a charge-coupled device, a charge-transfer device, or a charge-injection device.

1       4. The invention of claim 1, wherein the other circuitry is implemented within the integrated circuit.

1       5. The invention of claim 1, wherein step (a) is a standby mode for the image sensor.

1       6. The invention of claim 1, wherein step (a) is an integration step of a normal operation mode for the  
2 image sensor.

1       7. The invention of claim 6, wherein step (b) comprises the steps of:

2       (1) transferring the first portion of the charge from the photoelement to a storage device during a reset  
3 step of the normal operation mode for the image sensor; and  
4       (2) applying the first portion of the charge from the storage device to the other circuitry during a  
5 standby mode for the image sensor.

1       8. The invention of claim 7, wherein:

2       during a first phase of the reset step of the normal operation mode, the first portion of the charge is  
3 transferred from the photoelement to the storage device; and

4       during a second phase of the reset step of the normal operation mode, a second portion of the charge is  
5 discharged from the photoelement.

1       9. The invention of claim 8, wherein at least one control signal is generated to transition between the  
2 first phase and the second phase of the reset step.

1        10. The invention of claim 9, wherein voltage across the storage device is detected to generate the  
2 control signal.

1        11. The invention of claim 9, wherein the control signal is generated after a specified time interval.

1        12. The invention of claim 9, wherein current across the other circuitry is detected to generate the  
2 control signal.

1        13. The invention of claim 7, wherein:

2        during a first phase of the standby mode, power is applied to the other circuitry by the storage device;  
3 and  
4        during a second phase of the standby mode, power is applied to the other circuitry by the power  
5 supply.

1        14. The invention of claim 13, wherein at least one control signal is generated to transition between the  
2 first phase and the second phase of the standby mode.

1        15. The invention of claim 14, wherein voltage across the storage device is detected to generate the  
2 control signal.

1        16. The invention of claim 14, wherein the control signal is generated after a specified time interval.

1        17. The invention of claim 14, wherein current across the other circuitry is detected to generate the  
2 control signal.

1        18. The invention of claim 7, wherein the storage device is a capacitor implemented externally to the  
2 integrated circuit.

1        19. A circuit comprising:

2        (a) an image sensor having at least one photoelement implemented in an integrated circuit; and  
3        (b) other circuitry, wherein the photoelement generates charge that is applied to the other circuitry to  
4 reduce consumption of power from a power supply.

1        20. The invention of claim 19, wherein the circuit is powered by the power supply.

1        21. The invention of claim 19, wherein the photoelement is a photodiode, a phototransistor, a  
2        photogate, photo-conductor, a charge-coupled device, a charge-transfer device, or a charge-injection  
3        device.

1        22. The invention of claim 19, wherein the other circuitry is implemented within the integrated circuit.

1        23. The invention of claim 19, further comprising a storage device, wherein:  
2        during a reset step of the normal operation mode for the image sensor, the circuit is configured to  
3        transfer at least a first portion of the charge from the photoelement to the storage device; and  
4        during a standby mode for the image sensor, the circuit is configured to apply the first portion of the  
5        charge from the storage device to the other circuitry.

1        24. The invention of claim 23, wherein:  
2        during a first phase of the reset step, the circuit is configured to transfer the first portion of the charge  
3        from the photoelement to the storage device; and  
4        during a second phase of the reset step, the circuit is configured to discharge a second portion of the  
5        charge from the photoelement.

1        25. The invention of claim 24, further comprising a control circuit configured to generate at least one  
2        control signal to transition between the first phase and the second phase of the reset step.

1        26. The invention of claim 25, wherein the control circuit is configured to detect voltage across the  
2        storage device to generate the control signal.

1        27. The invention of claim 25, wherein the control circuit is configured to generate the control signal  
2        after a specified time interval.

1        28. The invention of claim 25, wherein the control circuit is configured to detect current across the  
2        other circuitry to generate the control signal.

1        29. The invention of claim 23, wherein:  
2        during a first phase of the standby mode, the circuit is configured to apply power to the other circuitry  
3        by the storage device; and  
4        during a second phase of the standby mode, the circuit is configured to apply power to the other  
5        circuitry by the power supply.

1        30. The invention of claim 29, further comprising a control circuit configured to generate at least one  
2 control signal to transition between the first phase and the second phase of the standby mode.

1        31. The invention of claim 30, wherein the control circuit is configured to detect voltage across the  
2 storage device to generate the control signal.

1        32. The invention of claim 30, wherein the control circuit is configured to generate the control signal  
2 after a specified time interval.

1        33. The invention of claim 30, wherein the control circuit is configured to detect current across the  
2 other circuitry to generate the control signal.

1        34. The invention of claim 23, wherein the storage device is a capacitor implemented externally to the  
2 integrated circuit.

1        35. The invention of claim 23, further comprising:  
2            a first set of one or more switches (e.g., 324 and 330 of Fig. 3) configured to selectively connect the  
3 storage device to the other circuitry; and  
4            a second set of one or more switches (e.g., 326 and 328) configured to selectively connect the power  
5 supply to the other circuitry.

1        36. The invention of claim 35, wherein:  
2            the first set of one or more switches comprises:  
3                a first switch (e.g., 322) configured between the storage device and the photoelement;  
4                a second switch (e.g., 324) configured between the storage device and a first terminal of the other  
5 circuitry ;  
6                a third switch (e.g., 332) configured between the storage device and a first terminal of the power  
7 supply; and  
8                a fourth switch (e.g., 330) configured between the storage device and a second terminal of the  
9 other circuitry; and  
10            the second set of one or more switches comprises:  
11                a fifth switch (e.g., 326) configured between the first terminal of the other circuitry and a second  
12 terminal of the power supply, and  
13                a sixth switch (e.g., 328) configured between the second terminal of the other circuitry and the first  
14 terminal of the power supply, wherein:

15        during a first phase of the reset step of the normal operation mode, the first, third, fifth, and sixth  
16    switches are closed and the second and fourth switches are open;  
17        during a second phase of the reset step of the normal operation mode, the first, second, third, and  
18    fourth switches are open and the fifth and sixth switches are closed;  
19        during a first phase of the standby mode, the first, third, fifth, and sixth switches are open and the  
20    second and fourth switches are closed; and  
21        during a second phase of the standby mode, the first, second, third, and fourth switches are open and  
22    the fifth and sixth switches are closed.

1        37. The invention of claim 19, further comprising:  
2        a first set of one or more switches (e.g. 422 and 424 of Fig. 4) configured to selectively connect the  
3    photoelement to the other circuitry;  
4        a second set of one or more switches (e.g. 420) configured to selectively connect the photoelement to  
5    the power supply.

1        38. The invention of claim 37, wherein:  
2        the first set of one or more switches comprises:  
3        a first switch (e.g. 422) configured between the negative node of the photoelement and a first  
4    terminal of the other circuitry;  
5        a second switch (e.g. 424) configured between the positive node of the photoelement and a second  
6    terminal of the other circuitry; and  
7        the second set of one or more switches comprises:  
8        a third switch (e.g. 420) configured between the negative node of the photoelement and the  
9    negative power supply, wherein:  
10        during the standby mode, the first and second switches are closed and the third switch is open;  
11        during normal operation, the first and second switches are open and the third switch is closed.